Specification:

Page 1, in the background section, the first paragraph, replace with the following new paragraph:

--- This invention is generally relative to a multiband Multiple-Input-Multiple-Output (MIMO)-based ~~Third Generation (3G)~~ Wideband Code Division Multiple Access (W-CDMA) and Ultra Wideband (UWB) Communications for [[a]] wireless and/or ~~fixed~~ local-area wireless communications.

Page 1, in the background section, the second paragraph, replace with the following new paragraph:

--- A MIMO is a multiple-input-multiple-output as a wireless link and is also a space-time signal processing. In the space-time signal processing, [[that]] a natural dimensional of transmitting data is complemented with a spatial dimension inherent in the use of multiple spatially distributed antennas. ~~In addition,~~ Thus, this leads that the MIMO is able to turn multipath propagation into benefit for a user. In a MIMO system, signals on the transmit antennas ~~at one end~~ and the receiver antennas ~~at the other end~~ are integrated in such a way that a quality of bit error rate (BER) or a data rate of the communication for each user or a transmitting distance is improved, thereby increasing a communication network's quality of service.

Page 1, in the background section, the third paragraph (extends to the page 2), replace with the following new paragraph:

--- The [[3G]] next-generation wireless communication is defined to allow [[the]] a subscriber to access [[the]] World Wide Web or to perform file ~~transfers~~ transferring over packet data connections capable of providing 144 kbps and 384 kbps for a mobility, and 2 Mbps in an indoor

environment. The W-CDMA is a wideband, spread spectrum radio interface that uses CDMA technology to meet the needs for the ~~3G of~~ next-generation wireless communication ~~systems~~. The W-CDMA (also known as CDMA2000) supports for a wide range of radio frequency (RF) channel bandwidths from 1.25 MHz to 15 MHz [[with]] operating [[of]] at 1.90 GHz band, where the channel sizes of 1, 3, 6, 9, and 12×1.25 MHz. [[The]] A wide channel[[s]] of the W-CDMA offers any combination of higher data rates, thereby ~~increase~~ enhancing total capacity ~~and/or increase range~~. The W-CDMA also employs a single carrier and a multicarrier system, which can be deployed as an overlay over one or more existing the second generation of TIA/EIA-95B 1.25 MHz channels. In [[the]] a multicarrier system, modulation symbols are de-multiplexed onto N separate 1.25 MHz carriers. Each carrier is spread with a 1.2288 Mcps chip rate.

Page 2, in the background section, the second paragraph, replace with the following new paragraph:

--- With regard to the UWB communications, U.S. Federal Communications Commission (FCC) released a revision of Part 15 of Commission's rules for UWB transmission systems on April 22, 2002. [[to]] FCC permitted the marketing and operation of certain types of new products, incorporating UWB technology ~~on April 22, 2002~~. Thus, UWB communication devices can operate using spectrum occupied by existing radio service without causing interference[[,]]. ~~thereby~~ This results permitting ~~scare~~ scarce spectrum resources to be used more efficiently. The UWB communication devices can offer significant benefits for Government, public safety, businesses, and consumers under an unlicensed basis of an operation spectrum.

Page 2, in the background section, the third paragraph (extends to the page 3), replace with the following new paragraph:

--- FCC is adapting unwanted emission limits for the UWB communication devices that are significantly more stringent than those imposed on other Part 15 devices. For [[the]] an indoor UWB operation, FCC provides a wide variety of the UWB communication devices, such as high-speed home and business networking devices under the Part 15 of the Commission's rules subject to certain frequency and power limitations. However, the UWB communication devices must operate in the frequency band ranges from 3.1 GHz to 10.6 GHz, and have an emission of −10 dBm for the indoor UWB operation. In addition, the UWB communication devices should also satisfy the Part 15.209 limit for the frequency band below 960 MHz. Table 1 lists the FCC restriction of the emission masks (dBm) along with the frequencies (GHz) for the UWB communication devices in [[the]] an indoor environment.

Table 1

Frequency (MHz)	EIRP (dBm)
0-960	-41.3
960-1610	-75.3
1610-1990	-53.3
1990-3100	-51.3
3100-10600	-41.3
Above 10600	-51.3

Page 3, in the background section, the second paragraph (extends to the page 4), replace with the following new paragraph:

--- The UWB communication devices are defined as any devices where [[the]] a fractional bandwidth (FB) is greater than 0.25 based on the following formula ~~as follows~~:

$$FB = 2\left(\frac{f_H - f_L}{f_H + f_L}\right), \qquad (1)$$

where f_H is the upper frequency of -10 dBm emission point[[s]], and f_L is the lower frequency of -10 dBm emission point[[s]]. A center transmission frequency F_c of the UWB communication devices is defined as [[the]] an average of the upper and lower -10 dBm emission points as follows:

$$\cancel{F_C = \frac{f_H - f_L}{2}. \qquad (2)}$$

$$F_C = \frac{f_H + f_L}{2}. \qquad (2)$$

Furthermore, a minimum frequency bandwidth of 500 MHz must be used for [[the]] indoor UWB communication devices regardless of the center ~~frequencies~~ frequency.

Page 4, in the background section, the second paragraph, replace with the following new paragraph:

--- The UWB communication devices can be designed [[used]] to use for wireless broadband communications within a short-distance range, particularly for a very high-speed data transmission suitable for broadband access to networks in the indoor environment.

Page 4, in the background section, the third paragraph (extends to the page 5), replace with the following new paragraph:

--- [[The]] A multiband MIMO-based [[3G]] W-CDMA and UWB communication transceiver system is disclosed herein according to some embodiments of the present invention. The invention system includes a

[[3G]] W-CDMA base station, [[and]] a UWB base station, and *P*-user dual-mode portable stations of ~~the 3G~~ W-CDMA and UWB communication devices. The W-CDMA base station ~~of the 3G W-CDMA~~ has a multicarrier for 12 channels with a total of 15-MHz frequency bandwidth at the center of 1.9 GHz frequency band, and employs four antennas at the transmitter and receiver. ~~On the other hand,~~ [[t]]The UWB communication base station ~~of the UWB communication in the indoor environment~~ uses a multicarrier for four frequency bands (referred to as a multiband[[s]]) with a total of 2.048-GHz frequency bandwidth in the frequency range from 3.1 GHz to 5.15 GHz, and also employs four antennas at the transmitter and receiver. Each of the ~~multibands~~ frequency bands in the UWB communications has a 512-MHz frequency bandwidth, ~~with use of~~ using an Orthogonal Frequency Division Multiplexing (OFDM) modulation. ~~For the 3G W-CDMA and UWB communication portable stations,~~ On the other hand, each of the *P*-user dual-mode portable stations of the [[3G]] W-CDMA and UWB communication devices uses two antennas, and shares some of common components, such as analog-to-digital (A/D) and digital-to-analog (D/A) converters, memory, etc. The [[3G]] W-CDMA in the dual-mode portable stations uses 12 channels with each channel of 1.25 MHz, has a multicarrier, and is able to transmit a data rate more than 2 Mcps, while the UWB employs four ~~multiband-based~~ frequency band-based multicarrier OFDM with each ~~of multiband~~ frequency band of 512 MHz, and can transmit a data rate up to 1.5872 Gbps. In addition, all of the dual-mode portable station use a direct sequence spread spectrum (DSSS), which is a pseudorandom (PN) sequence to spread a user signal. The DSSS is used to separate signals coming from multiuser. Thus, [[the]] multiple access interference (MAI) among multiuser can be avoided when a set of PN sequences is designed with as low cross-correlation as possible.

Page 5, in the background section, the second paragraph (extends to the page 6), replace with the following new paragraph:

--- [[The]] <u>An</u> OFDM is an orthogonal multicarrier modulation technique that has its capability of multifold increasing symbol duration. [[With]] [[i]]<u>I</u>ncreasing the number of subcarriers in the OFDM modulation, the frequency selectivity of a channel may be reduced so that each subcarrier experiences flat fading for the UWB communications. Thus, [[the]] <u>an</u> OFDM approach is a particular useful for the UWB communication<u>s</u> over a short-range fading channel.

Page 6, in the background section, the second paragraph, replace with the following new paragraph:

--- The present invention of the multiband MIMO-based [[3G]] W-CDMA and UWB communications utilizes both benefits of ~~the 3G~~ W-CDMA wireless phones and [[the]] UWB wireless broadband communication<u>s</u>. Such a dual-mode device not only can transmit the packet data in a form of wireless phone but also can use as a very-high speed wireless broadband Internet device to transmit and receive data, image, video, video game, music, and stock graph, etc., in a real-time. Thus, there is a continuing need of the multiband MIMO-based [[3G]] W-CDMA and UWB communication transceiver system for delivering a very-high data rate with a capability of flexibility and scalability in a combination form of the wireless and fixed wireless environment.

Page 6, in the summary section, the third paragraph (extends to the page 7), replace with the following new paragraph:

--- In accordance with one aspect, a multiband MIMO-based dual-mode portable station of [[3G]] W-CDMA and UWB communication receiver comprises a MIMO-based dual-mode [[3G]] W-CDMA and UWB filtering and multicarrier <u>Radio Frequency (RF)</u> section, a [[3G]] W-

CDMA baseband processor, an UWB OFDM multiband baseband processor, a [[3G]] W-CDMA and UWB OFDM multiband control processor, and a multiple antenna unit.

Other aspects are set forth in the accompanying detailed description and claims.

Page 7, in the brief description of the drawings section, extends to the page 9, replace with the following new paragraphs:

--- FIG. 1 is a block diagram of ~~showing~~ a multiband MIMO-based [[3G]] W-CDMA and UWB communication transceiver system including *P*-user dual-mode portable stations of [[3G]] W-CDMA and UWB, and two ~~separate~~ different base stations of the [[3G]] W-CDMA and UWB communication according to some embodiments.

--- FIG. 2 is a block diagram of ~~showing~~ a MIMO-based [[3G]] W-CDMA base station [[with]] employing four antennas according to some embodiments.

--- FIG. 3 is a detailed block diagram of ~~showing~~ a [[3G]] W-CDMA baseband processor of the base station according to some embodiments.

--- FIG. 4 is a detailed block of ~~showing~~ a MIMO-based [[3G]] W-CDMA filtering and multicarrier RF section according to some embodiments.

--- FIG. 5 is a detailed block diagram of ~~showing~~ a [[3G]] W-CDMA mapping, spreading, and filtering section according to some embodiments.

--- FIG. 6 is a detailed block diagram of ~~showing~~ a [[3G]] W-CDMA analog filtering and multicarrier modulation section according to some embodiments.

--- FIG. 7 is a block diagram of ~~showing~~ a MIMO-based UWB base station according to some embodiments.

--- FIG. 8 is a detailed block diagram of ~~showing~~ an UWB base station according to some embodiments.

--- FIG. 9 is a detailed block diagram of ~~showing~~ a MIMO-based UWB spreading and filtering section according to some embodiments.

--- FIG. 10 is a detailed block diagram of ~~showing~~ a MIMO-based UWB modulation and multicarrier RF section according to some embodiments.

--- FIG. 11 is a frequency spectrum output of the MIMO-based UWB base station transmitter for the indoor operation according to one embodiment.

--- FIG. 12 is a block diagram of ~~showing~~ a [[3G]] W-CDMA and UWB portable station for a single user according to some embodiments.

--- FIG. 13 is a detailed block diagram of ~~showing~~ a MIMO-based dual-mode 3G W-CDMA and UWB filtering and multicarrier RF section according to some embodiments.

--- FIG. 14 is a detailed block diagram of ~~showing~~ a [[3G]] W-CDMA down converter and demodulation according to some embodiments.

--- FIG. 15 is a detailed block diagram of ~~showing~~ an UWB multiband down converter and demodulation according to some embodiments.

--- FIG. 16 is a detailed block diagram of ~~showing~~ an analog-to-digital converter according to some embodiments.

--- FIG. 17 is a detailed block diagram of ~~showing~~ a [[3G]] W-CDMA baseband processor in the dual-mode portable station according to some embodiments.

--- FIG. 18 is a detailed block diagram of ~~showing~~ a [[3G]] W-CDMA multiband rake receiver and decoder unit according to some embodiments.

--- FIG. 19 is a detailed block diagram of ~~showing~~ a UWB OFDM multiband baseband processor according to some embodiments.

--- FIG. 20 is a detailed block diagram of ~~showing~~ a combination section of a digital receiver filter unit, a multiband despreading unit, and a time-domain equalizer (TEQ) unit according to some embodiments.

--- FIG. 21 is a detailed block diagram of ~~showing~~ a combination section of a fast Fourier transform (FFT) unit and a frequency-domain equalizer (FEQ) unit according to some embodiments.

--- FIG. 22 is a detailed block diagram of ~~showing~~ a despreading, deinterleaver, and decoding unit according to some embodiments.

Page 9, in the detailed description section, extends from the page 9 to the page 10, replace with the following new paragraph:

--- Some embodiments described herein are directed to the multiband MIMO-based [[3G]] W-CDMA and UWB transceiver system for [[a]] wireless and fixed wireless communications. Such a dual-mode transceiver system [[may]] can be implemented in hardware, such as in an Application Specific Integrated Circuits (ASIC), digital signal processor, field programmable gate array (FPGA), software, or a combination of hardware and software.

Page 10, in the detailed description section, the second paragraph (extends to the page 11), replace with the following new paragraph:

--- A multiuser MIMO-based [[3G]] W-CDMA and UWB system 100 for the wireless and fixed wireless communications is shown in FIG. 1 in accordance with one embodiment of the present invention. Dual-mode [[3G]] W-CDMA and UWB portable stations [[of]] from 110a to 110p can simultaneously communicate with either a MIMO-based [[3G]] W-CDMA base station 140 or a MIMO-based UWB base station 170 to transmit and [[to]] receive information data. The dual-mode [[3G]] W-CDMA and UWB portable station 110a transmits and receives the [[3G]] W-CDMA or the UWB information data through its two antennas of $120a_1$ and $120a_2$. The base station of the [[3G]] W-CDMA 140 or the UWB base station 170 communicates with the dual-mode [[3G]] W-CDMA and UWB portable station 110a through the [[3G]] W-CDMA's four antennas [[of]] from 130a to 130d or through the UWB's four antennas [[of]] from 160a to 160d, respectively. In a similar way, other dual-mode [[3G]] W-CDMA and UWB portable stations [[of]] from 110b to 110p also transmit and

receive the information data through their antennas [[of]] from $120b_1$ and $120b_2$ to $120p_1$ and $120p_2$, respectively, and communicate with either the [[3G]] W-CDMA base station 140 through the antennas [[of]] from 130a to 130d or the UWB base station 170 through the antennas [[of]] from 160a to 160d. The [[3G]] W-CDMA base station 140 is coupled to a [[3G]] W-CDMA network interface section 150, [[in]] which is connected with a [[3G]] W-CDMA network 152. The UWB base station 170 is connected with an UWB network interface section 180 that is coupled to an UWB network 182.

Page 11, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- The MIMO-based [[3G]] W-CDMA base station 140 can transmit multiuser's information data at the same time. After scrambling with [[the]] a long code corresponding to user p, the user data is de-multiplexed onto N carriers, where N equals to 3, 6, 9, or 12. On each carrier, the demultiplexed bits are mapped onto I and Q followed by using Walsh spreading. For reverse closed loop power control, [[the]] power control bits may be punctured onto the forward link channel at a rate of 800 Hz. Then, [[the]] a signal on each carrier is orthogonally spread by [[the]] an appropriate Walsh code function in such a way that a fixed chip rate of 1.2288 Mcps can be maintained per carrier. [[The]] Walsh codes may differ on each carrier. The signal on each carrier is then complex PN spread followed by using a baseband filtering and binary phase-shifted keying (BPSK) or quaternary phase-shifted keying (QPSK) modulation. The [[3G]] W-CDMA base station 140 can transmit and receive the data rate from 144 kbps to greater than 2 Mbps and supports [[for]] a wide range of RF channel bandwidths, including 1.25 MHz, 3.75 MHz, 7.5 MHz, 11.25 MHz, and 15 MHz.

Page 12, in the detailed description section, the first paragraph, replace with the following new paragraph:

--- The MIMO-based UWB base station 170, [[with]] knowing all of the UWB PN sequences of the dual-mode [[3G]] W-CDMA and UWB portable stations [[of]] from 110a to 110p, can transmit and receive all of the UWB information data from all of the dual-mode [[3G]] W-CDMA and UWB portable stations [[of]] from 110a to 110p by spreading and despreading of the user PN sequences on the multiband. The MIMO-based UWB base station 170 uses a BPSK or a QPSK modulation and a carrier for each of the multiband to transmit and [[to]] receive the information data rate of 396.8 Mbps on one frequency band. As a result, the MIMO-based UWB base station 170 can simultaneously transmit and/or receive the maximum data rate up to 1.5872 Gbps by using all of the four frequency bands. In addition, the UWB base station 170 is able to transmit the data rate with an enhancement of a longer range due to use the multiple antennas.

Page 12, in the detailed description section, the second paragraph (extends to the page 13), replace with the following new paragraph:

--- FIG. 2 is a block diagram 200 of ~~showing~~ the MIMO-based [[3G]] W-CDMA base station 140 according to some embodiments. The MIMO-based [[3G]] W-CDMA base station 140 includes a [[3G]] W-CDMA baseband processor 210, a MIMO-based [[3G]] W-CDMA filtering and multicarrier RF section 220 coupled to four antennas [[of]] from 130a to 130d, and a [[3G]] W-CDMA control processor 230. The [[3G]] W-CDMA baseband processor 210 deals with a multiuser digital signal processing of a physical layer including turbo or convolution encoder and decoder, block interleaver and deinterleaver, spreading and dispreading. The MIMO-based [[3G]] W-CDMA filtering and multicarrier RF section 220 provides filtering, modulation, and transmits W-CDMA signal

through the antennas [[of]] from 130a to 130d. The [[3G]] W-CDMA control processor 230 supports a data frame information, and controls the [[3G]] W-CDMA baseband processor 210 and the MIMO-based [[3G]] W-CDMA filtering and multicarrier RF section 220.

Page 13, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- The MIMO-based [[3G]] W-CDMA base station 140 is able to transmit and receive multiuser information data through multichannel with multicarrier simultaneously. There are a total of 12 multicarriers for a wide range of RF channel bandwidths of 1.25 MHz, 3.75 MHz, 7.5 MHz, 11.25 MHz, and 15 MHz. The signal on each carrier is orthogonally spread by the appropriate Walsh code at the chip rate of 1.2288 Mcps. Then, the signal on each carrier is filtered and modulated by using the baseband filtering and BPSK or QPSK modulation. The MIMO-based [[3G]] W-CDMA base station 140 can transmit and/or receive the data rate from 144 kbps to ~~greater~~ more than 2 Mbps.

Page 13, in the detailed description section, the third paragraph (extends to the page 14), replace with the following new paragraph:

--- Referring to FIG. 3 is a detailed block diagram 300 of ~~showing~~ the [[3G]] W-CDMA baseband processor 210 according to some embodiments. A turbo or convolution encoder 310 that is used to encode the user information data is coupled to a symbol repetition 320. The symbol repetition 320 can repeat a frame symbol data with 2-time, 4-time or 8-time. The output of the symbol repetition 320 is interleaved by using a block interleaver 330. The output data of the block interleaver 330 is scrambled with a long code from a bit selector 360 by using an exclusive OR (XOR) 370. A long code mask for user *p* 340 is coupled to a long code generator 350 that is connected with a bit selector 360. The scrambled data

of the XOR 370 output is demultiplexed onto 12 parallel data [[with]] label<u>ed</u> [[of]] <u>from</u> d_1 to d_{12} by using a demultiplexer 380.

Page 14, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- FIG. 4 is a block diagram 400 of ~~showing~~ the MIMO-based [[3G]] W-CDMA filtering and multicarrier RF section 220 according to some embodiments. The MIMO-based 3G W-CDMA filtering and multicarrier RF section 220 includes a [[3G]] W-CDMA mapping spreading and filtering 410 and a [[3G]] W-CDMA analog filtering and multicarrier modulation 420. The [[3G]] W-CDMA mapping spreading and filtering 410 is coupled to the [[3G]] W-CDMA analog filtering and multicarrier modulation 420. The 12 parallel signals [[of]] <u>from</u> d_1 to d_{12} are passed through the [[3G]] W-CDMA mapping spreading and filtering 410 to produce 12 parallel output signals, which are used as the input signals for the [[3G]] W-CDMA analog filtering and multicarrier modulation 420. Then the [[3G]] W-CDMA analog filtering and multicarrier modulation 420 produce<u>s</u> four parallel signals for the transmitter through four antennas [[of]] <u>from</u> 130a to 130d.

Page 14, in the detailed description section, the third paragraph (extends to the page 15), replace with the following new paragraph:

--- Referring to FIG. 5 is a detailed block diagram 500 of ~~showing~~ the [[3G]] W-CDMA mapping, spreading and filtering 410 according to some embodiments. The 12 parallel input signals [[of]] <u>from</u> d_1 to d_{12} are passed through 12 MUX and IQ mapping units [[of]] <u>from</u> 510a to 510m. The output I and Q signals of the MUX and IQ mapping units [[of]] <u>from</u> 510a to 510m are spread by using Walsh codes [[of]] <u>from</u> W_{m1} to W_{m12}, respectively. Then signals are complex PN spread by using complex PN spreading units [[of]] <u>from</u> 530a to 530m, followed by baseband filters

[[of]] from $540a_1$ and $540a_2$ to $540m_1$ and $540m_2$. Analog-to-digital (A/D) converter units [[of]] from $550a_1$ and $550a_2$ to $550m_1$ to $550m_2$ convert all of the digital signals of the baseband filter outputs [[of]] from $540a_1$ and $540a_2$ to $540m_1$ and $540m_2$ into parallel analog signals [[of]] from a_{11} and a_{12} to a_{121} and a_{122}.

Page 15, in the detailed description section, the second paragraph (extends to the page 16), replace with the following new paragraph:

--- Referring to FIG. 6 is a detailed block diagram 600 of ~~showing~~ the [[3G]] W-CDMA analog filtering and multicarrier modulation 420 according to some embodiments. The input signals [[of]] from a_{11} and a_{12} to a_{121} and a_{122} are in parallel passed through analog filters [[of]] from $610a_1$ and $610a_2$ to $610m_1$ and $610m_2$ to produce reconstructed analog signals. Each pair of the output signals of the analog filters [[of]] from $610a_1$ and $610a_2$ to $610m_1$ and $610m_2$ is performed QPSK modulation with multicarrier by using each pair of multipliers $620a_1$ and $620a_2$ and one addition 630a, to multipliers $620m_1$ and $620m_2$ and one addition 630m, respectively. The 12 QPSK signals with multicarriers are grouped together into four signals by using four additions [[of]] from 640a to 640d, respectively, followed by four baseband filters (BPF) [[of]] from 650a to 650d to produce signals for power amplifier and antennas.

Page 16, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- FIG. 7 is a block diagram 700 of ~~showing~~ the MIMO-based UWB base station 170 according to some embodiments. An UWB baseband processor 710, [[that]] which performs convolution encoder and decoder, interleaver and deinterleaver, and inverse fast Fourier transform (IFFT) and fast Fourier transform (FFT) functions, is coupled to a MIMO-based UWB spreading and filtering 720, followed by a MIMO-based UWB modulation

and multicarrier RF section 730. The MIMO-based UWB modulation and multicarrier RF section 730 is connected with four antennas [[of]] from 160a to 160d. An UWB control processor 740 is used to control a frame information and ~~control~~ entire process among the units of the MIMO-based UWB base station 170, the MIMO-based UWB spreading and filtering 720, and MIMO-based UWB modulation and multicarrier RF section 730.

Page 16, in the detailed description section, the second paragraph (extends to the page 18), replace with the following new paragraph:

--- Referring to FIG. 8 is a detailed block diagram 800 of ~~showing~~ the UWB baseband processor 710 according to some embodiments. There are a number of *p* users [[with]] from a user-1 bitstream 810a to a user-*p* bitstream 810p, respectively. The user-1 bitstream 810a is coupled to a 1/2-rate convolution encoder 812a ~~in which~~ that is connected to an interleaver 814a. Using a unique PN sequence of a user-1 key 822a spreads the output sequence of the interleaver 814a. In a similar way, the user-*p* bitstream 810p is coupled to the 1/2-rate convolution encoder 812p that is connected to the interleaver 814p. Using the unique PN sequence of the user-p key 822p spreads the output sequences of the interleaver 814p. All of the PN sequences of the user-1 key 822a to the user-*p* key 822p are orthogonal each other. This means that a cross-correlation between one PN sequence and other PN sequences is almost zero, while a self-correlation of a user PN sequence is almost equal to one. Then, the *p* output sequences from the interleaver 814a to the interleaver 814p in a parallel operation are added together to form a serial sequence output by using a sum over block duration 830. The serial output of the sum over block duration 830 is converted into four parallel sequences by using a polyphase-based multiband 840. Thus, the first of the output sequence from the polyphase-based multiband 840 is converted into a 512-parallel

sequence by using a~~[n]~~ serial-to-parallel (S/P) 850a. The 512-parallel sequence is formed to a 512-parallel complex sequence with symmetric conjugates. The 512-parallel complex sequence is passed through an IFFT 852a to produce a 1024-parallel real sequence. The IFFT 852a is coupled to a guard 854a to insert 256 samples as a guard interval for the output sequence of the IFFT 852a. As a result, the output of the guard 854a is a 1280-parallel real sequence. Then, the outputs of the guard 854a are used to form a serial signal p_1 by using a parallel-to-serial (P/S) 856a. In the same way, the fourth of the output sequence from the polyphase-based multiband 840 is converted into a 512-parallel sequence by using a~~[n]~~ S/P 850k. The 512-parallel sequence is formed to a 512-parallel complex sequence with symmetric conjugates. The 512-parallel complex sequence is passed through an IFFT 852d to produce a 1024-parallel real sequence. The IFFT 852d is coupled to a guard 854d to insert 256 samples as a guard interval for the output sequence of the IFFT 852d. Thus, the output of the guard 854d is a 1280-parallel real sequence. The guard interval is used to avoid an intersymbol interference (ISI) between IFFT frames. Finally, the outputs of the guard 854d are used to form a serial signal p_4 by using a P/S 856d.

Page 18, in the detailed description section, the first paragraph, replace with the following new paragraph:

--- The data rate-dependent parameters of the 1024-point IFFT operation 852 is listed in Table 2 for each of the ~~multi-~~frequency bands as follows:

Table 2

Four band frequency data rate (Gbits/s)	One frequency band data rate (Mbits/s)	Modulation	Coding rate	Coded bits per sub-carrier	Coded bits per OFDM symbol	Data bits per OFDM symbol
0.7936	198.4	BPSK	1/2	1	992	496
1.5872	396.8	QPSK	1/2	2	1984	992

Page 19, in the detailed description section, the first paragraph, replace with the following new paragraph:

--- The corresponding 1024-point IFFT of detailed timing-related parameters for each of the ~~multi-~~frequency bands is listed in Table 3:

Table 3

Parameters	Descriptions	Value
N_{ds}	Number of data subcarriers	992
N_{ps}	Number of pilot subcarriers	8
N_{ts}	Number of total subcarriers	1000
D_{fs}	Frequency spacing for subcarrier (512MHz/1024)	0.5 MHz
T_{FFT}	IFFT/FFT period ($1/D_{fs}$)	2.0 μs
T_{gd}	Guard duration ($T_{FFT}/4$)	0.5 μs
T_{signal}	Duration of the signal BPSK-OFDM symbol ($T_{FFT} + T_{gd}$)	2.5 μs
T_{sym}	Symbol interval ($T_{FFT} + T_{gd}$)	2.5 μs
T_{short}	Short duration of training sequence ($10 \times T_{FFT}/4$)	5.0 μs
T_{gd2}	Training symbol guard duration ($T_{FFT}/2$)	1.0 μs
T_{long}	Long duration of training sequence ($2 \times T_{FFT} + T_{gd2}$)	5.0 μs
$T_{preamble}$	Physical layer convergence procedure preamble duration ($T_{short} + T_{long}$)	10.0 μs

Page 19, in the detailed description section, the second paragraph (extend to the page 20), replace with the following new paragraph:

--- Referring to FIG. 9 is a detailed block diagram 900 of ~~showing~~ the MIMO-based spreading and filtering section 720 according to some embodiments. There are four input signals [[of]] <u>from</u> p_1 to p_4. The input signal of p_1 is demultiplexed by using a demultiplexer 910a to produce I and Q signals. The I and Q signals are spread with an output sequence of a multiband spreading 930a by using XORs of 920a and 920b to produce spread I and Q signals, followed by two transmitter shaped filters of $940a_1$ and $940a_2$, respectively. Then, the output signals of the transmitter shaped

filters of $940a_1$ and $940a_2$ are passed through two D/A converters of $950a_1$ and $950a_2$, followed by two analog filters of $960a_1$ and $960a_2$ to smooth the analog signals, respectively. In the same way, the input signal of p_4 is demultiplexed by using a demultiplexer 910d to produce I and Q signals. The I and Q signals are spread with an output sequence of a multiband spreading 930d by using XORs $920d_1$ and $920d_2$ to produce spread I and Q signals, followed by two transmitter shaped filters of $940d_1$ and $940d_2$, respectively. Then, the output signals of the transmitter shaped filters of $940d_1$ and $940d_2$ are passed through two D/A converters of $950d_1$ and $950d_2$, followed by two analog filters of $960d_1$ and $960d_2$ to smooth the analog signals, respectively. Thus, the MIMO-based spreading and filtering section of 720 converts four digital sequences onto four I and four Q spread analog signals with multicarrier for transmitter section.

Page 20, in the detailed description section, the second paragraph (extends to the page 21), replace with the following new paragraph:

--- Referring to FIG. 10 is a detailed block diagram 1000 of ~~showing~~ the MIMO-based UWB modulation and multicarrier RF section 730 according to some embodiments. The input signals [[of]] from I_1 and Q_1 to I_4 and Q_4 are modulated in a QPSK format with multicarriers by using multipliers of $1010a_1$ and $1010a_2$ and an addition from 1012a to $1010d_1$ and $1010d_2$ and an addition 1012d to produce RF signals [[of]] from o_1 to o_2. Then, the signals [[of]] from o_1 to o_2 are summed together to form four RF signals with multicarriers by using additions [[of]] from 1020a to 1020d, followed by using analog bandpass filters [[of]] from 1030a to 1030d. The output RF signals of the analog bandpass filters [[of]] from 1030a to 1030d are passed through the power amplifier (PA) [[of]] from 1040a to 1040d onto antennas.

Page 21, in the detailed description section, the second paragraph (extend to the page 22), replace with the following new paragraph:

--- FIG. 11 is an output frequency spectrum 1100 of the MIMO-based UWB base station communication transmitter, including four ~~multi-~~frequency band spectrums of 1120, 1130, 1140 and 1150 according to some embodiments. A FCC emission limitation 1110 for the indoor UWB operation is also shown in FIG. 11. Each transmitter frequency bandwidth of all the ~~multi-~~frequency band spectrums of 1120, 1130, 1140 and 1150 is 512 MHz and is fitted under the indoor FCC emission limitation 1110 with different carrier frequencies. The detail positions of each ~~transmitter multi-~~frequency band spectrums (dBm) along with the center, lower and upper frequencies (GHz) as well as the channel frequency bandwidth (MHz) are listed in Table 4:

Table 4

Multichannel Label	Center Frequency (GHz)	Lower Frequency (GHz)	Upper Frequency (GHz)	Frequency Bandwidth (MHz)
1120	3.357	3.101	3.613	512
1130	3.869	3.613	4.125	512
1140	4.381	4.125	4.637	512
1150	4.893	4.637	5.149	512

Page 22, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- During the indoor UWB operation, the MIMO-based UWB base station transmitters can avoid [[an]] interference with <u>wireless local area network (WLAN)</u> 802.11a lower U-NII frequency band in the frequency range of 5.15 GHz to 5.35 GHz since the highest spectrum of the MIMO-based UWB base station transmitter is at 5.149 GHz<u>,</u> [[in]] which is lower than 5.15 GHz in WLAN 802.11a lower band.

Page 22, in the detailed description section, the third paragraph (extends to the page23), replace with the following new paragraph:

--- FIG. 12 is a block diagram 1200 of ~~showing~~ a dual-mode MIMO-based receiver of the [[3G]] W-CDMA and UWB portable station 110a according to some embodiments. A dual-mode MIMO-based [[3G]] W-CDMA, UWB filtering and multicarrier RF section 1210 receives RF signals from two antennas of $120a_1$ and $120a_2$ and converts RF signals to either [[3G]] W-CDMA digital signals or UWB digital signals. The dual-mode MIMO-based [[3G]] W-CDMA, UWB filtering and multicarrier RF section 1210 is coupled to a [[3G]] W-CDMA baseband processor 1220 and an UWB OFDM multiband baseband processor 1230. During the [[3G]] W-CDMA mode, the [[3G]] W-CDMA baseband processor 1220 receives the W-CDMA digital signals from the dual-mode MIMO-based [[3G]] W-CDMA, UWB filtering and multicarrier RF section 1210 to perform digital filtering, demultiplexer, rake receiver, dispreading, deinterleaver, and decoding processes. During the UWB mode, the UWB OFDM multiband baseband processor 1230 receives the UWB digital signals from the dual-mode MIMO-based [[3G]] W-CDMA, UWB filtering and multicarrier RF section 1210 to deal with digital filtering, multiband dispreading, time-domain equalizer (TEQ), FFT, frequency-domain equalizer (FEQ), dispreading, deinterleaver, and decoding. A [[3G]] W-CDMA and UWB OFDM multiband control processor 1240 is used to control data flow among blocks of the dual-mode MIMO-based [[3G]] W-CDMA, UWB filtering and multicarrier RF section 1210, the [[3G]] W-CDMA baseband processor 1220, the UWB OFDM multiband baseband processor 1230, and a sharing memory bank 1250.

Page 23, in the detailed description section, the second paragraph (extends to the page 24), replace with the following new paragraph:

--- Referring to FIG. 13 is a detailed block diagram 1300 of ~~showing~~ the dual-mode MIMO-based [[3G]] W-CDMA, UWB filtering and multicarrier RF section 1210 according to some embodiments. Two low noise amplifiers (LNA) of 1310a and 1310b receive RF signals from two antennas, respectively, and amplify RF signals. The LNA of 1310a and 1310b respectively connect with two automatic gain controls (AGC) of 1320a and 1320b, followed by two analog baseband filters of 1330a and 1330b. Two outputs of the analog baseband filter 1330a are passed to two switch units of 1340 and 1344. In the same way, two outputs of the analog baseband filter 1330b are passed to the switch units of 1340 and 1344. During the [[3G]] W-CDMA mode, two switches of 1342a and 1342b in the switch unit 1340 connect with the outputs from the analog baseband filters of 1330a and 1330b. The output signals, *a* and *b*, of the switch unit 1340 are passed into a [[3G]] W-CDMA down converter and demodulation 1350, [[in]] which produces two analog baseband signals, g_1 and g_2, for an A/D unit 1370. During the UWB mode, two switches of 1346a and 1346b in the switch unit 1344 connect with the outputs from the analog baseband filters of 1330a and 1330b. The output signals, *c* and *d*, of the switch unit 1344 are passed into an UWB multiband down converter and demodulation 1360 that generates eight analog baseband signals, u_1, u_2, u_3, u_4, u_5, u_6, u_7, and u_8, for an A/D unit 1370.

Page 24, in the detailed description section, the second paragraph (extends to the page 25), replace with the following new paragraph:

--- Referring to FIG. 14 is a detailed block diagram 1400 of ~~showing~~ the [[3G]] W-CDMA down converter and demodulation 1350 according to some embodiments. The input signals of *a* and *b* are sum<u>med</u> together by using a [[3G]] W-CDMA sum over a block duration 1410. The output

signals of the [[3G]] W-CDMA sum over the block duration 1410 convert into two parallel signals that are demodulated with <u>the</u> multicarrier of 1420a and 1420b, followed by two channel select filters of 1430a and 1430b to produce desired signals of g_1 and g_2, respectively.

Page 25, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- Referring to FIG. 15 is a detailed block diagram 1500 of ~~showing~~ the UWB multiband down converter and demodulation 1360 according to some embodiments. The input signals of c and d are sum<u>med</u> together by using an UWB sum over the block duration 1510 to produce four parallel signals for four multiband down converters and demodulations [[of]] <u>from</u> 1520a to 1520d. The multiband down converters and demodulations [[of]] <u>from</u> 1520a to 1520d perform down converter and demodulation, and produce eight analog baseband signals [[of]] <u>from</u> u_1 to u_8.

Page 25, in the detailed description section, the third paragraph (extends to the page 26), replace with the following new paragraph:

--- Referring to FIG. 16 is a detailed block diagram 1600 of ~~showing~~ the A/D unit 1370 according to some embodiments. There are two switch units of 1620 and 1640 and eight A/D converters [[of]] <u>from</u> 1650a to 1650h, with a sampling ~~frequency~~ rate at 540 MHz. During the [[3G]] W-CDMA mode, two switches of 1620 and 1640 connect to the input signals of g_1 and g_2, respectively. The outputs of the switches of 1610 and 1630 are passed into two A/D converters of 1650a and 1650b, with the sampling ~~frequency~~ rate at 540 MHz. This is 36 times oversampling for the [[3G]] W-CDMA signals. Other A/D converters [[of]] <u>from</u> 1650c to 1650h are rest. The output signals au_1 and au_2 of the A/D converters of 1650a and 1650b will be used in the W-CDMA baseband processor. During the UWB mode, the switches of 1620 and 1640 connect to the input signals of

u_1 and u_2, respectively. The outputs of the switches of 1610 and 1630, and input signals of u_3 to u_8 are in parallel passed onto eight A/D converters [[of]] from 1650a to 1650h, where the sampling ~~frequency~~ rate is 540 MHz for all the A/D converters. The output signals of the A/D converters [[of]] from 1650a to 1650h are referred to as au_1 to au_8, which will be used in the UWB baseband processor.

Page 26, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- FIG. 17 is a detailed block diagram 1700 of ~~showing~~ the [[3G]] W-CDMA baseband processor 1220 according to some embodiments. The input signals of au_1 and au_2 are passed through two digital filters of 1710a and 1710b, followed by two down samplings of 1720a and 1720b, respectively. The output signals of the down samplings of 1720a and 1720b are multiplexed by using a multiplexer (MUX) 1730. Then, the output signal of the MUX 1730 is passed to a multiband rake receiver and decoder unit 1740 to produce a user data stream.

Page 26, in the detailed description section, the third paragraph (extends to the page 27), replace with the following new paragraph:

--- Referring to FIG. 18 is a detailed block diagram 1800 of ~~showing~~ the multiband rake receiver and decoder unit 1740 according to some embodiments. The input signal is digitally demodulated to form 12 multiband baseband signals by using multipliers [[of]] from 1810a to 1810m. The 12 multiband baseband signals are passed through 12 digital filters [[of]] from 1820a to 1820m to produce the desired signals, followed by using 12 despreader and rake units [[of]] from 1830a to 1830m. Then 12 parallel output signals of the despreader and rake units [[of]] from 1830a to 1830m are multiplexed together by a MUX 1840 to produce a serial signal. The serial signal is thus despread by using a long code

sequence that is generated by using a long code generator 1852 based on a long code user-*p* mask 1850. The output signal of the despreader 1854 is deinterleaved by using a deinterleaver 1860, followed by using a desymbol repetition 1870 and a decoder 1880 to produce the user-*p* data stream.

Page 27, in the detailed description section, the second paragraph (extends to the page 28), replace with the following new paragraph:

--- FIG. 19 is a detailed block diagram 1900 of ~~showing~~ the UWB OFDM multiband baseband processor 1230 according to some embodiments. The eight input signals [[of]] from au_1 to au_8 are passed through a digital receiver filter unit 1910, followed by a multiband dispreading unit 1920 and a TEQ unit 1930 to produce four parallel signals. The TEQ unit 1930 is used to reduce the length of cyclic prefix to a more manageable number without reducing performance significantly. In other words, the TEQ unit 1930 can produce a new target channel with a much smaller effective constraint length when concatenated with the channel. Thus, the outputs of the TEQ unit 1930 in parallel are passed through four S/Ps [[of]] from 1940a to 1940d to produce parallel digital sequences. Each of the S/Ps [[of]] from 1940a to 1940d produces 1280 parallel digital sequences for each of guard removing units [[of]] from 1942a to 1942d. The guard removing units [[of]] from 1942a to 1942d remove 256 samples from the 1280 parallel digital sequences of the S/Ps of 1940a to 1940d to produce 1024 parallel digital sequences, which are used as inputs for FFT units [[of]] from 1944a to 1944d. Each of the FFT units [[of]] from 1944a to 1944d produces 512 frequency-domain signals that are used for frequency-domain equalizer (FEQ) units [[of]] from 1946a to 1946d. The FEQ units [[of]] from 1946a to 1946d are used to compensate for phase distortions, which are a result of phase offsets between the sampling clocks in the transmitter and the receiver of the MIMO-based multiband of

the UWB communication transceiver. This is because the phases of the received outputs of the multiband FFT units [[of]] from 1944a to 1944d are unlikely to be exactly the same as the phases of the transmitter symbols at the input to the IFFT units [[of]] from 852a to 852d of the MIMO-based multiband of UWB base station transmitter as shown in FIG. 8. Thus, the outputs of the FEQ units [[of]] from 1946a to 1946d are passed through a set of P/S units [[of]] from 1948a to 1948d and a P/S 1950 to produce a serial sequence for all of the four ~~multi-~~frequency bands. Thus, the output sequence of the P/S 1950 is used for a despreading, deinterleaver, and decoding unit 1960, which performs despreading, deinterleaving, and decoding for the MIMO-based multiband of the UWB mobile communication receiver.

Page 28, in the detailed description section, the second paragraph (extends to the page 29), replace with the following new paragraph:

--- Referring to FIG. 20 is a detailed block diagram 2000 of ~~showing~~ a combination 1970 of the digital receiver filter unit 1910, the multiband dispreading unit 1920, and the TEQ unit 1930 according to some embodiments. The eight input signals [[of]] from au_1 to au_8 are in parallel passed through the digital receiver filters [[of]] from $2010a_1$ and $2010a_2$ to $2010d_1$ and $2010d_2$, respectively. The output signals of the digital receiver filters [[of]] from $2010a_1$ and $2010a_2$ to $2010d_1$ and $2010d_2$ are despread by using XORs [[of]] from $2020a_1$ and $2020a_2$ to $2020d_1$ and $2020d_2$ with the output sequences of multiband dispreading [[of]] from 2030a to 2030d. Then, every pair of the output signals of the XOR [[of]] from $2020a_1$ and $2020a_2$ to $2020d_1$ and $2020d_2$ are multiplexed together by using MUXs [[of]] from 2040a to 2040d, followed by using TEQ [[of]] from 2050a to 2050d.

Page 29, in the detailed description section, the second paragraph (extends to the page 30), replace with the following new paragraph:

--- FIG. 21 is a detailed block diagram 2100 of ~~showing~~ a combination 1980 including the FFT 1944 and the FEQ 1946 according to some embodiments. The FFT 1944 has a 1024-point input of real-value and produces a 512-point complex data ~~with labels of~~ labeled from 0 to 511, while a 512-point complex data ~~with labels of~~ labeled from 511 to 1023 is disable. The FFT 1944 ~~with labels of~~ labeled from 0 to 511 also contains 12 Nulls. So, the FFT 1944 produces a 500-point complex data for the FEQ 1946. The FEQ 1946 contains 500 equalizers [[of]] from $2110a_1$ to $2110a_{500}$, 500 decision detectors [[of]] from $2120a_1$ to $2120a_{500}$, and 500 subtractions [[of]] from $2130a_1$ to $2130a_{500}$ that operate in parallel. Each of the equalizers [[of]] from $2110a_1$ to $2110a_{500}$ has N-tap with adaptive capability. Each of the decision detectors [[of]] from $2120a_1$ to $2120a_{500}$ is a multi-level threshold decision. Each of the subtractions [[of]] from $2130a_1$ to $2130a_{500}$ performs subtracting between the output of each of the equalizers [[of]] from $2110a_1$ to $2110a_{500}$ and the output of each of the decision detectors [[of]] from $2120a_1$ to $2120a_{500}$. The output of each of the subtraction [[of]] from $2130a_1$ to $2130a_{500}$ is referred to an error signal, which is used to adjust the N-tap coefficients of the each of the equalizers [[of]] from $2110a_1$ to $2110a_{500}$ by using an adaptive algorithm 2130.

Page 30, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- The phases of the received outputs of the FFT 1944 do not have exactly the same as the phases of the transmitter symbols at the input to the IFFT units [[of]] from 852a to 852d of the MIMO-based multiband of UWB base station transmitter as shown in FIG. 8. In addition, the phase responses have to consider the channel in which is coped with the TEQ 1930 as shown in FIG. 19. Thus, the FEQ 1946 in FIG. 21 is used to

compensate for the phase distortion that is a result of a phase offset between the sampling clocks in the transmitter and the receiver of the MIMO-based multiband of the UWB communication transceiver. The FEQ 1946 also offers the additional benefit of received signal scaling before decoding since the FEQ 1946 can be used to adjust the gain of the FFT 1944 output so that the decision detectors [[of]] from $2120a_1$ to $2120a_{500}$ can be set the same parameters for all subchannels regardless of the different subchannel attenuations.

Page 30, in the detailed description section, the third paragraph (extends to the page 31), replace with the following new paragraph:

--- FIG. 22 is a detailed block diagram 2200 of ~~showing~~ the despreading, deinterleaver, and decoding unit 1960 according to some embodiments. This unit 1960 includes a despreading 2210, a user-*i* key 2220, a deinterleaver 2230, a Viterbi decoding 2240, and a user-*i* bitstream 2250. The input signal is despread with a spreading sequence of the user-i key 2220, which provides a unique key sequence, by using the despreading 2210. The despreading 2210 is a XOR operation to produce an encoded user-*i* data bitstream. This encoded user-*i* data bitstream is then deinterleaved by using the deinterleaver 2230 that is also coupled to the Viterbi decoding 2240. The Viterbi decoding 2240 decodes the encoded user-*i* data bitstream to produce an original transmitted user-*i* data bitstream that is stored into the user-*i* bitstream 2250.

Page 31, in the detailed description section, the second paragraph, replace with the following new paragraph:

--- While the present invention[[s]] [[have]] has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom. ~~It is intended that the~~ The following ~~appended~~ claims cover all such modifications and variations as fall within the true spirit and scope of the[[se]] present invention[[s]].

What is claimed is: